U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
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HW:eb

26 APR 1967

From: Commanding Officer and Director
To: Director, Defense Atomic Support Agency (APRS)

Subj: USNRDL FY 1969 DASA Biomedical NWER Subtask Summaries (Proposals); submission of

Ref: (a) DASA ltr STMD of 23 Mar 1967
(b) BuMed ltr BUMED-7131 of 15 Mar 1967
(c) NAVSHIPS ltr 9903 Ser 03541-41 of 10 Mar 1967
(d) DASA ltr APRS of 6 Mar 1967 to Multi Addees

Encl: USNRDL FY 1969 DASA Biomedical NWER Subtask Summaries (Proposals) (5 cys ea):
(1) 03.035 - Lethality and Recovery from Radiation Injury
(2) 03.161 - The Effect of High Energy Neutron Irradiation on Mammalian Systems
(3) 03.___ - The Effects of Radiation on Performance Capabilities
(4) 03.___ - Quantitative Biochemical Dosimetry of Radiation Exposure
(5) 03.___ - Partial Body Irradiation: Biological Effects of Shielding

1. In accordance with the instructions outlined in references (a) through (d), the USNRDL FY 1969 DASA Biomedical Subtask Summaries are submitted as enclosures (1) through (5).

D. C. CAMPBELL

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Date	4/24/67	4/24/67	4/24	4/24		24 Apr 67	4/25	

c. Determine the influence of exposure rate on acute lethality (LD_{50}). The LD_{50} of animals will be determined at several exposure rates ranging from 4 R/hr to 660 R/hr. These experiments relating exposure rate to mortality should provide better estimates or guidelines as to personnel hazards posed by chronic gamma-ray exposure.

d. Evaluate the influence of size or amount of the protracted exposure on injury accumulation and recovery pattern in several animal species. Animals will be subjected to different amounts of chronic gamma irradiation, e.g., 165 R and 300 R (conditioning exposure) at some predetermined exposure rate and the amount of injury accumulation determined immediately thereafter. Recovery patterns will be determined by measuring the LD_{50}'s at several times subsequent to the chronic radiation injury.

3. References:

TR-998, 24 Mar 1966, Injury Accumulation in Sheep During Protracted Gamma Radiation, Leong, G. F., Page, N. P., Ainsworth, E. J., and Hanks, G. E.

TR-1053, 29 July 1966, Injury Accumulation and Recovery in Sheep Exposed to Protracted Co^{60} Gamma Radiation, Hanks, G. E., Ainsworth, E. J., Leong, G. F., Nachtwey, D. S. and Page, N. P.; Radiation Res. 29: 211-221, 1966.

Radiation Res. 27: 397-405, 1966, Acute Mortality and Recovery Studies in Sheep Irradiated with Cobalt-60 Gamma or 1 MVP X Rays, Hanks, G. E., Page, N. P., Ainsworth, E. J., Leong, G. F. Menkes, C. K. and Alpen, E. L.

TR-67-22, 10 Jan 1967, The Relationship of Exposure-rate and Exposure-time to Radiation Injury in Sheep, Page, N. P., Ainsworth, E. J. and Leong, G. F.

C. PROGRESS ANL TIME FRAME OF ACCOMPLISHMENT

1. Current FY (FY 1967):

a. Influence of Exposure Rate on Acute Lethality: Studies of the influence of exposure rate on mortality ($LD_{50/60}$) in sheep indicate that through the range of 30 R/hr to 660 R/hr, the LD_{50} appears to be linearly related to exposure rate. However, the LD_{50}'s at 3.9 and 2.0 R/hr departed from this relationship and were considerably higher than would be predicted by the extrapolation of a line through the LD_{50}'s at the three highest exposure rates. This is probably attributable to recovery occurring during protracted irradiation.

Comparisons of dose rate effects show that the LD_{50} for situations involving a 96 hour exposure is approximately twice the LD_{50} for a 1 hour exposure. This is in direct contradiction to current military doctrine that LD_{50}'s for exposures of 96 hours and 1 hour are the same.

b. Influence of Size of Conditioning Exposure on Injury Accumulation in Sheep and Swine: Studies with sheep relating the size of the conditioning exposure at a fixed exposure rate of 3.9 R/hr to injury accumulation have been completed. Injury appears to accumulate as a linear function of the exposure dose between 75-475 R, and although the data do not statistically depart from linearity, the better fit of a line to the data may be slightly curved. Comparable studies of injury accumulation at a lower exposure rate, 2.0 R/hr, suggest a similar relationship, i.e., a departure from linearity at the lowest conditioning exposures which is probably related to recovery processes. Since the recovery rate of swine is appreciably faster than that of sheep, studies with swine have been initiated to determine the injury accumulation at 4 R/hr. This should provide comparative information in the kinetics of injury accumulation for two large animal species which have different recovery rates.

c. Influence of Exposure Rate on Recovery in Sheep: Earlier studies at a high exposure rate (660 R/hr) demonstrate that the recovery pattern of sheep after sublethal irradiation exposure (2/3 LD_{50}, 165 R) is characterized by an initial period of little or no recovery for 10 days followed by rapid recovery. By 16 days the animals "over recover" to the extent of approximately 140% of the LD_{50} of unconditioned animals and by 24 days the sheep show 25-30% remaining injury. At a lower exposure rate, 3.9 R/hr, the recovery pattern of sheep subjected to 2/3 LD_{50} conditioning exposure (165 R) shows no initial shoulder indicating initial rapid recovery. Other experiments relating the size of the conditioning exposure at 3.9 R/hr recovery rate indicate that animals receiving higher exposures recover more slowly. The phenomenon of transient radioresistance has been demonstrated for animals subjected to either high (660 R/hr) or low (3.9 R/hr) exposure rates.

d. Effect of Exposure Rate on LD_{50} in Mice: Related studies on the dependence of biological effect on dose rate in mice have established a critical dose rate above which LD_{50} is independent of dose. For 30 day LD_{50}, the critical dose rate is between 1600 and 800 R/hr. At dose rates below this value, the LD_{50} increases on a linear scale with decreasing logarithm of the dose rate. Studies are now in progress to determine the extent to which the relationship of log dose rate to LD_{50} holds.